

Overview

Standard & Code Considerations for Stationary Fuel Cell Installations In the United States

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Know Your Audience

- **Authorities Having Jurisdiction**
 - What type of plan checker for site build permit?
 - What type of in-field inspectors are expected?
 - Who will be the final permit approvers for operation?
- **Electric utilities**
 - Different levels of knowledge of distributed generation throughout most US-based utilities

*Be a resource for **interpretation** of codes and standards*



Sell the Technology & Safety of Installation

Entire site will be built and fuel cells installed per existing, typical plumbing, gas, electrical, other, code requirements:

there are, however, well established, fuel cell-specific standards & codes!

Ensure that permit approvers understand that they can contribute to regional leadership in promoting clean energy

Conventional Energy Production

Power Generation

+

Transmission



Not quick to permit & build these!

Distributed Generation Technologies

Fuel Cell Power Systems



Microturbine



Diesel/Gas Genset



Wind Turbine



Solar / Photovoltaic



Specific Stationary Fuel Cell Standards & Codes

- NFPA 853 for installation
- NFPA 70 (NEC), Article 692 for installation
- ANSI/CSA America FC 1-2004 for design/construction
- IEEE P1547 for grid connections
- UL 1741 for grid connections



Installation Requirements & Codes

NFPA 853 – Standard for Installation of Stationary Fuel Cell Power Systems

- General equipment configuration
- Siting and interconnections
- Fuel supplies and storage arrangements
- Ventilation and exhaust
- Fire protection

Manufacturer's installation instructions

Installation Requirements & Codes

NFPA 70 (National Electrical Code), Article 692 Fuel Cell Systems

- Circuit requirements
 - Circuit sizing and current
 - Overcurrent protection
- Disconnecting means
- Wiring methods
- Grounding
- Markings
- Connection to other circuits
 - Utility interactive (Article 692.65, 2008 NEC)

System Design for Safe Operation

ANSI/CSA America FC 1-2004 Standard for Stationary Fuel Cell Power Systems

- Construction, Performance, Quality Assurance
- Nationally Recognized Test Laboratory Listing

System & Site Designed for Safe Operation

- Software Control Safety Features
- Hardware Control Safety Features
- External Manual Shut-Offs



EPO Shuts Down Systems



System Disconnects



Shuts Off Gas

Interconnection with Electric Power Systems

IEEE P1547 *Standard for Interconnecting Distributed Resources with Electric Power Systems*

- Technical requirements for DG interconnection
- Addresses requirements relevant to *performance, operation, testing, safety considerations, and maintenance* of the interconnection

Interconnection with Electric Power Systems

IEEE P1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

Generator device protective relay settings

- Abnormal voltage & frequency settings
- Anti-islanding protection
- Reconnection time
- Breaker synchronization

Generator impact on power quality

- Voltage flicker
- DC injection
- Harmonic distortion
- Voltage regulation limits/modes

Other

- Interaction with utility system grounding
- Field & commissioning tests
- Surge withstand ratings

Interconnection with Electric Power Systems

UL 1741: Inverters, Converters & Controllers for Use in Independent Power Systems

- Anti islanding provisions / protection

Other References to Fuel Cells

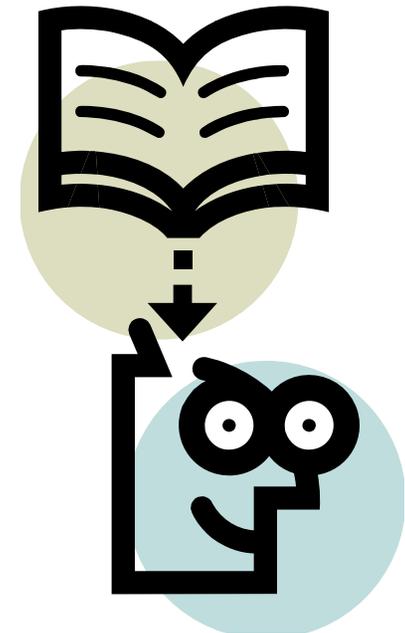
Stationary fuel cells are also referenced specifically:

- Uniform Mechanical Code – Chapter 16
- International Mechanical Code – Section 924.1
- International Fuel Gas Code – Section 633.1

Practical permitting for Dummies

- Know your audience
- Know your technology
- Know relevant codes and standards

Communicate and educate!



Thank you!